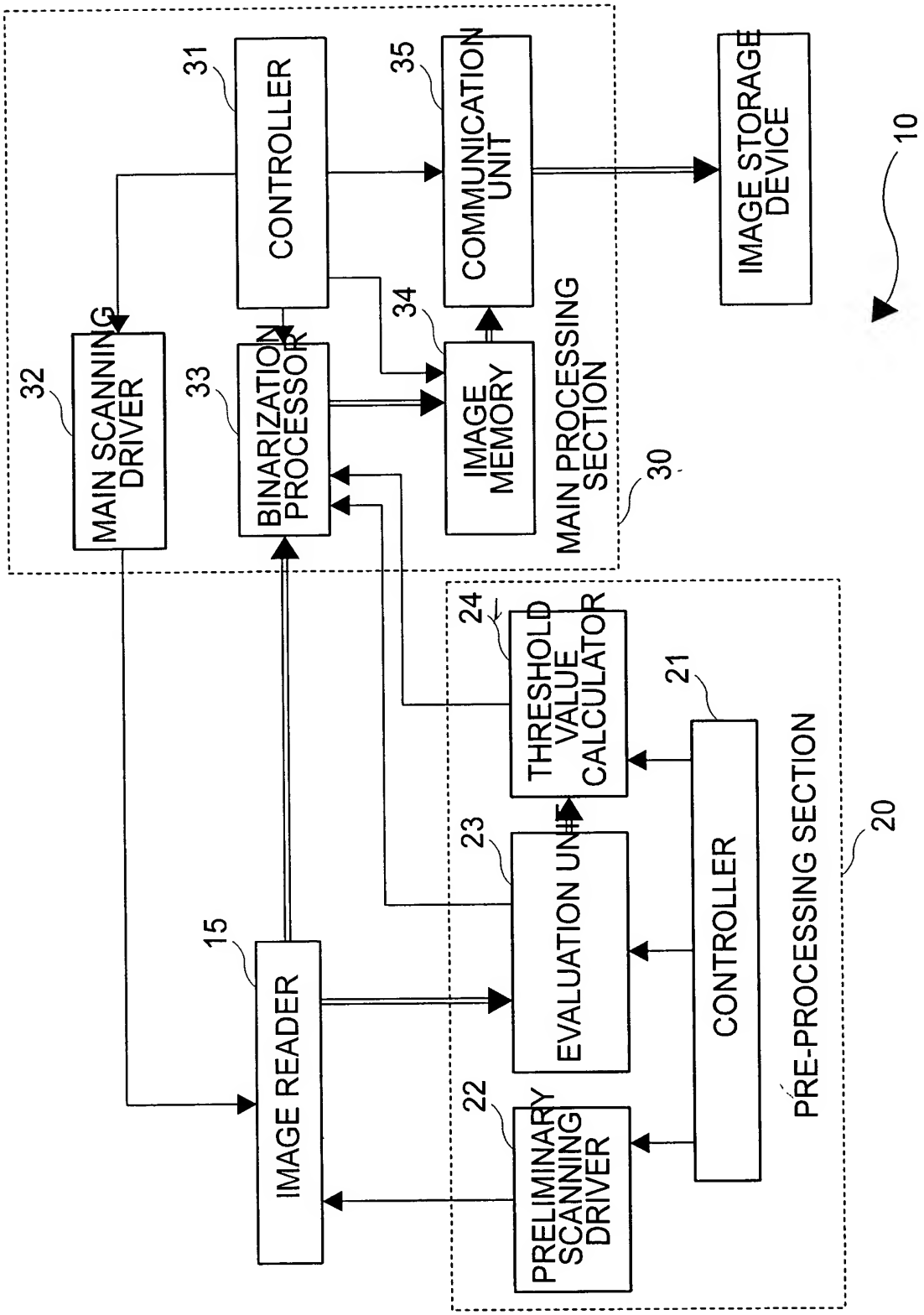
10
IMAGE STORAGE DEVICE
MAIN PROCESSING SECTION
30
CONTROLLER
31
COMMUNICATION UNIT
35
MAIN SCANNING DRIVER
32
BINARIZATION PROCESSOR
33
IMAGE MEMORY
34
PRE-PROCESSING SECTION
20
THRESHOLD VALUE CALCULATOR
24
EVALUATION UNIT
23
CONTROLLER
21
IMAGE READER
15
PRELIMINARY SCANNING DRIVER
22

FIG. 1

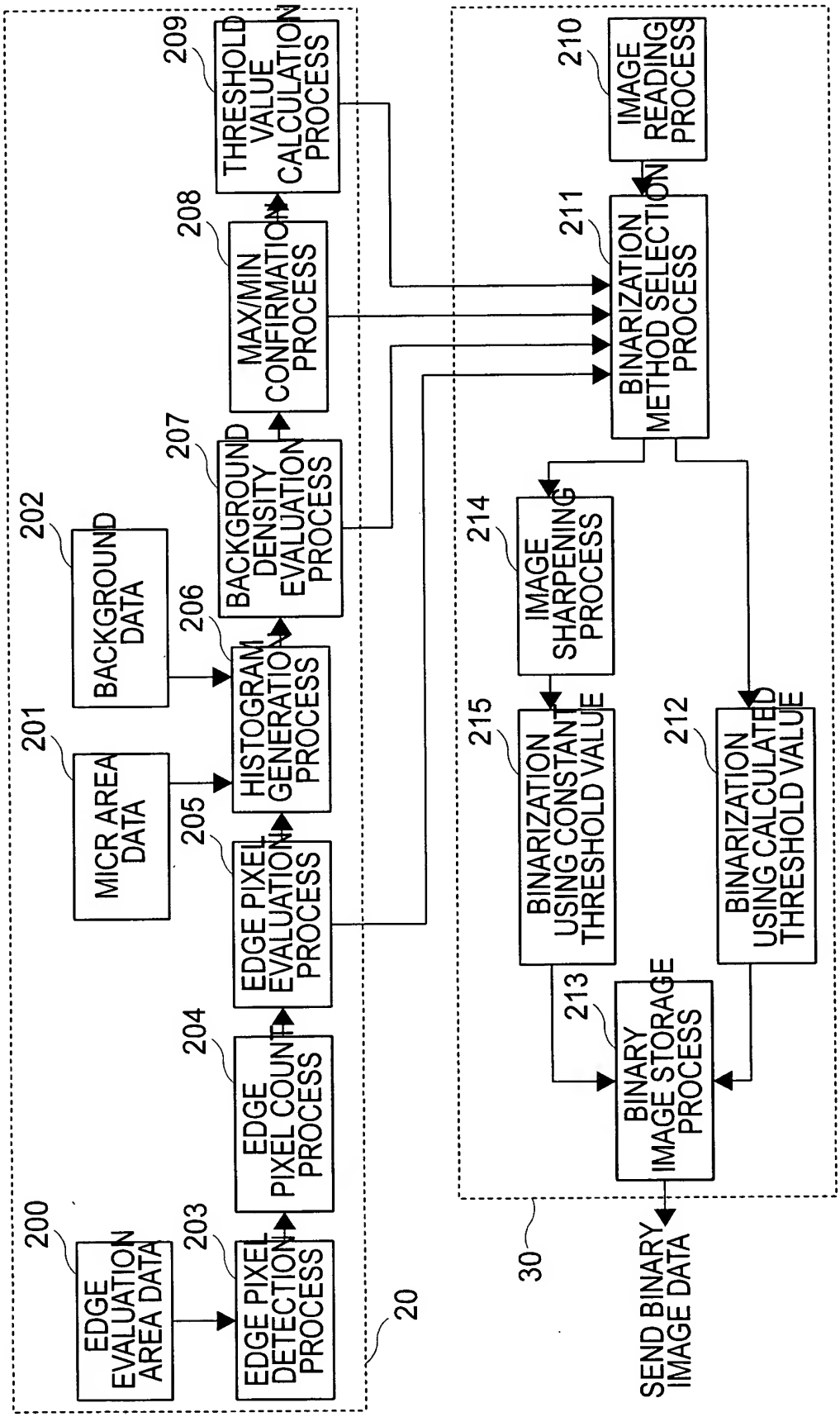
EDGE EVALUATION AREA DATA
200
EDGE PIXEL DETECTION PROCESS
203
EDGE PIXEL COUNT PROCESS
204
EDGE PIXEL EVALUATION PROCESS
205
HISTOGRAM GENERATION PROCESS
206
BACKGROUND DENSITY EVALUATION PROCESS
207
MAX/MIN CONFIRMATION PROCESS
208
THRESHOLD VALUE CALCULATION PROCESS
209
MICR AREA DATA
201
BACKGROUND DATA
202
20
IMAGE READING PROCESS
210
BINARIZATION METHOD SELECTION PROCESS
211
IMAGE SHARPENING PROCESS
214
BINARIZATION USING CONSTANT THRESHOLD VALUE
215
BINARIZATION USING CALCULATED THRESHOLD VALUE
212
BINARY IMAGE STORAGE PROCESS
213
30
SEND BINARY IMAGE DATA

FIG. 2

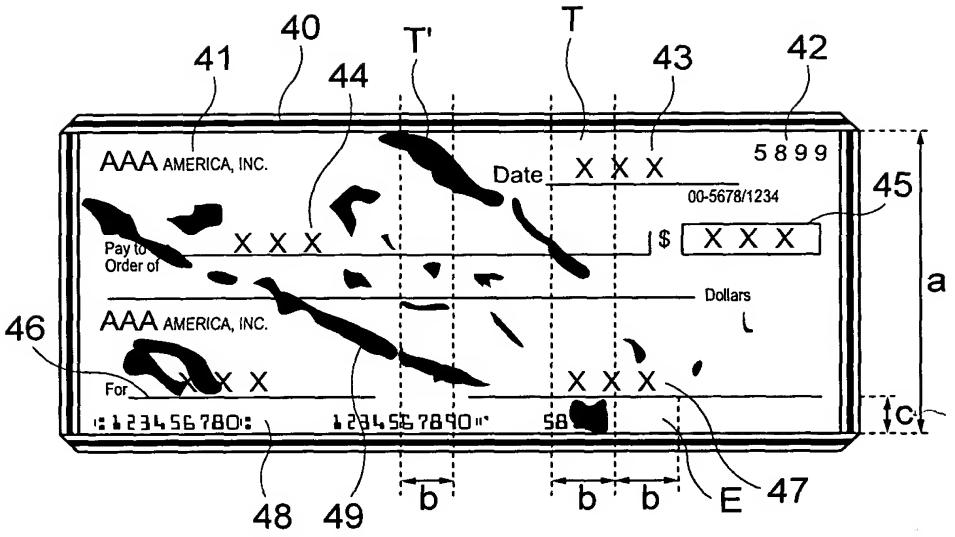
41
40
T'
T
43
42
44
AAA AMERICA, INC.
5899
Date X X X
00-5678/1234
45
Pay to the Order of
X X X
$ X X X
Dollars
a
46
AAA AMERICA, INC.
For
X X X
X X X
c
48
49
b
b
b
E
47

FIG. 3

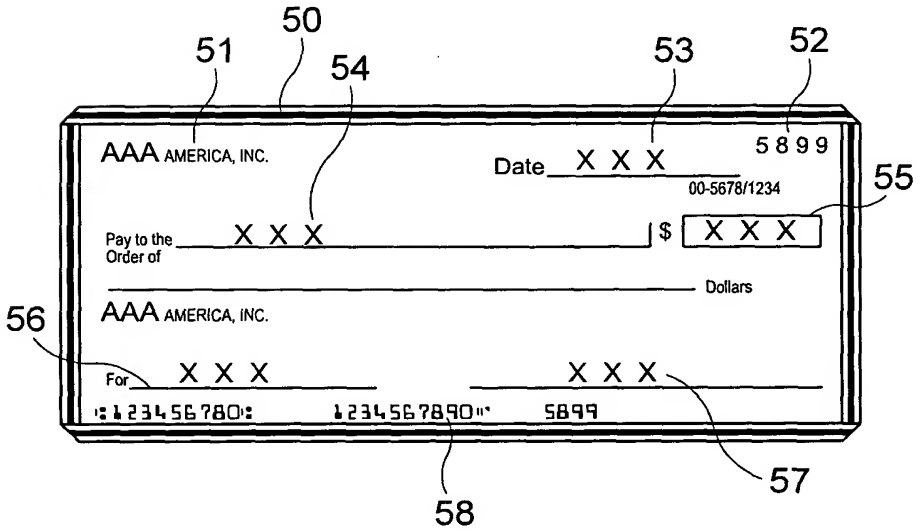
51
50
54
53
52
AAA AMERICA, INC.
5899
Date X X X
00-5678/1234
55
Pay to the Order of
X X X
$ X X X
Dollars
56
AAA AMERICA, INC.
For
X X X
X X X
5899
57
58

FIG. 4

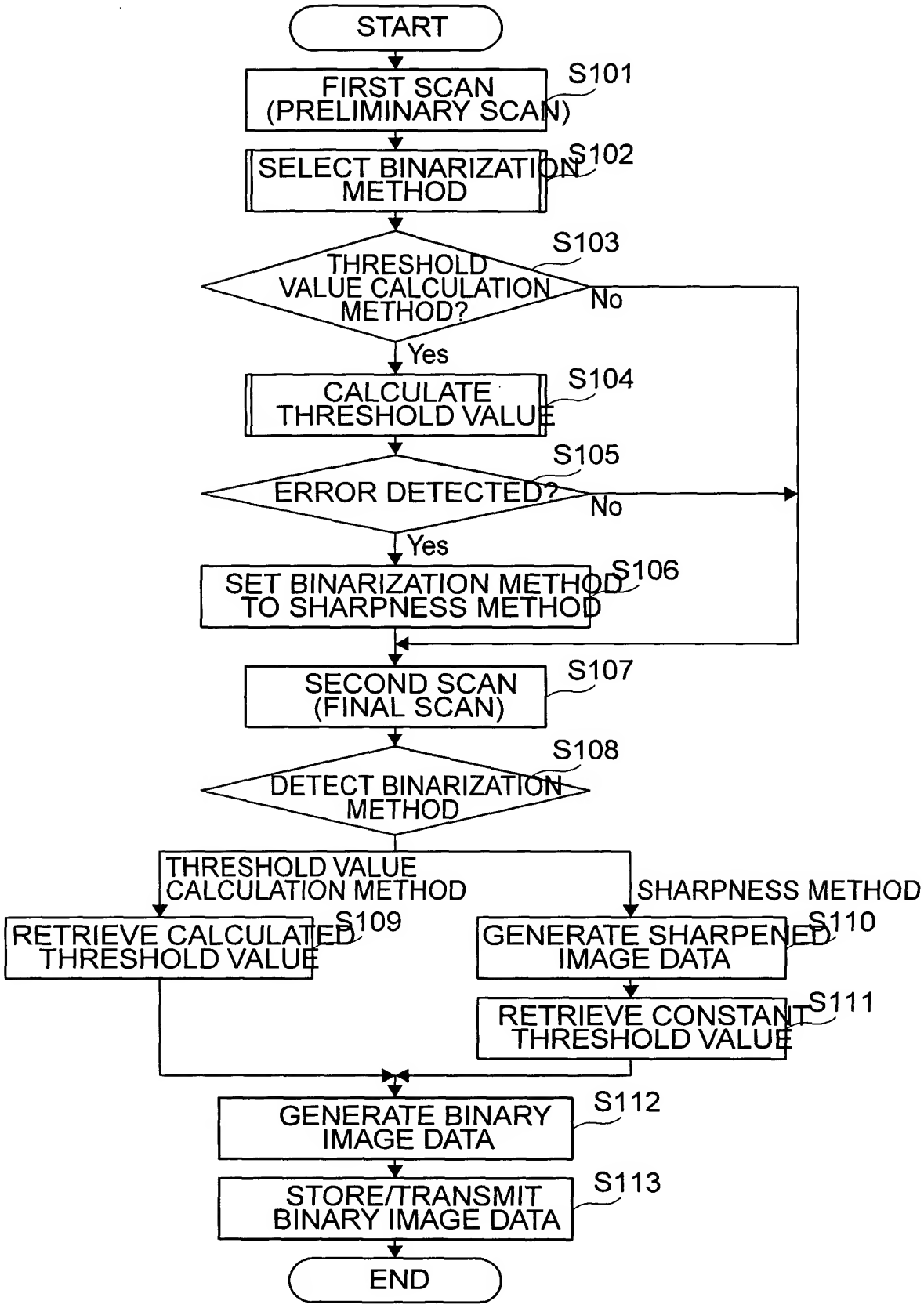
START
FIRST SCAN (PRELIMINARY SCAN)
S101
SELECT BINARIZATION METHOD
S102
THRESHOLD VALUE CALCULATION METHOD?
S103
No
Yes
CALCULATE THRESHOLD VALUE
S104
ERROR DETECTED?
S105
No
Yes
SET BINARIZATION METHOD TO SHARPNESS METHOD
S106
SECOND SCAN (FINAL SCAN)
S107
DETECT BINARIZATION METHOD
S108
THRESHOLD VALUE CALCULATION METHOD
SHARPNESS METHOD
RETRIEVE CALCULATED THRESHOLD VALUE
S109
GENERATE SHARPENED IMAGE DATA
S110
RETRIEVE CONSTANT THRESHOLD VALUE
S111
GENERATE BINARY IMAGE DATA
S112
STORE/TRANSMIT BINARY IMAGE DATA
S113
END

FIG. 5

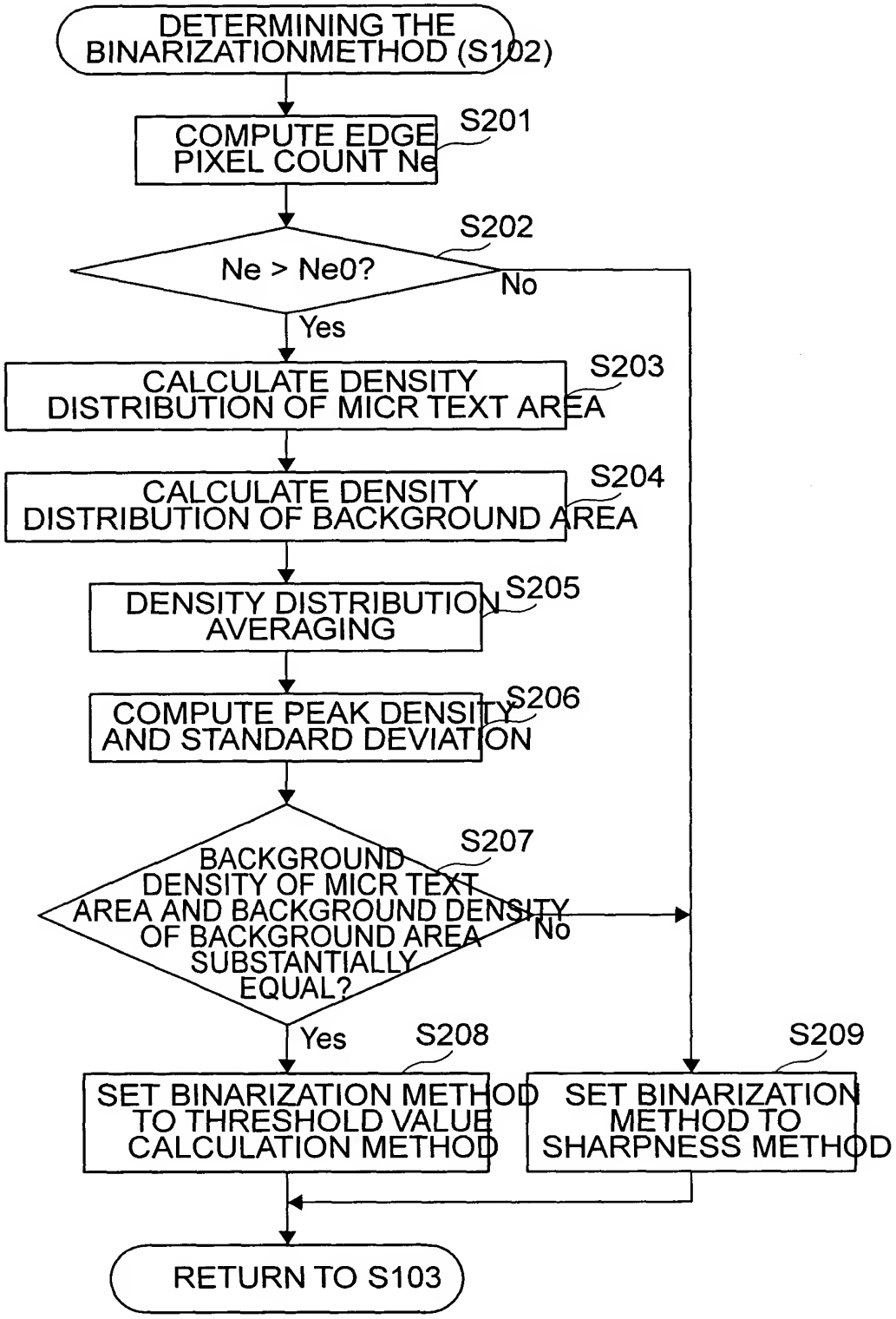
DETERMINING THE BINARIZATIONMETHOD (S102)
COMPUTE EDGE PIXEL COUNT Ne
S201
Ne > Ne0?
S202
No
Yes
CALCULATE DENSITY DISTRIBUTION OF MICR TEXT AREA
S203
CALCULATE DENSITY DISTRIBUTION OF BACKGROUND AREA
S204
DENSITY DISTRIBUTION AVERAGING
S205
COMPUTE PEAK DENSITY AND STANDARD DEVIATION
S206
BACKGROUND DENSITY OF MICR TEXT AREA AND BACKGROUND DENSITY OF BACKGROUND AREA SUBSTANTIALLY EQUAL?
S207
No
Yes
S208
S209
SET BINARIZATION METHOD TO THRESHOLD VALUE CALCULATION METHOD
SET BINARIZATION METHOD TO SHARPNESS METHOD
RETURN TO S103

FIG. 6

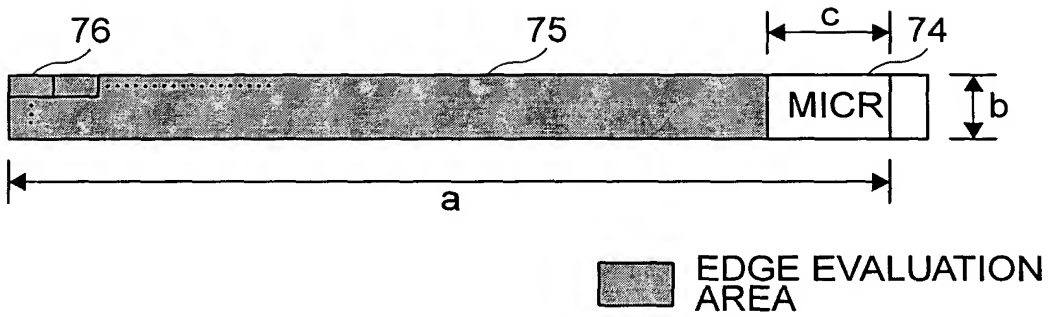
76
75
c
74
MICR
b
a
EDGE EVALUATION AREA

FIG. 7 (a)

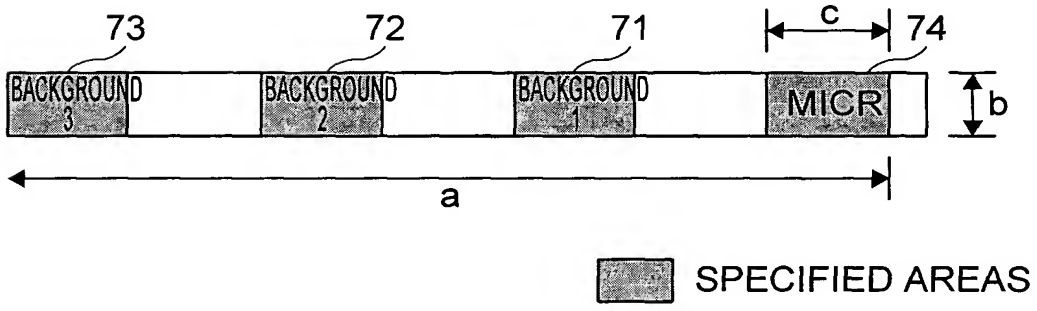
73
72
71
c
74
BACKGROUND 3
BACKGROUND 2
BACKGROUND 1
MICR
b
a
SPECIFIED AREAS

FIG. 7 (b)

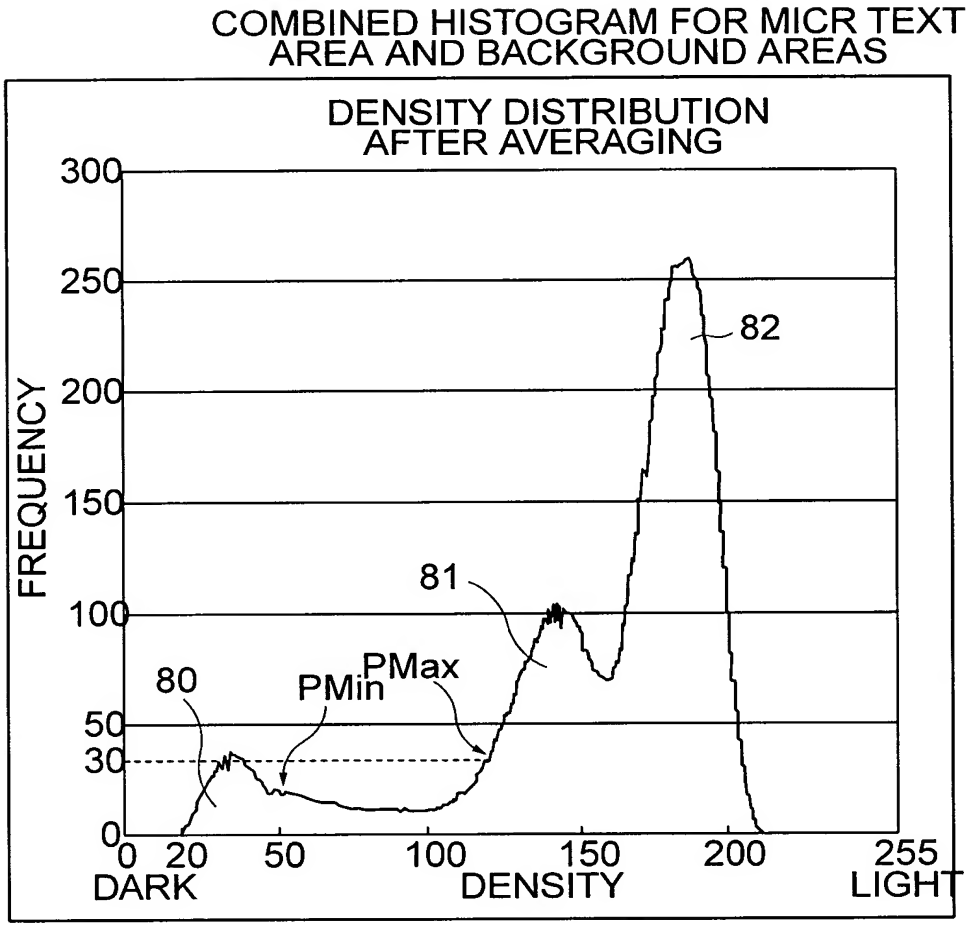
COMBINED HISTOGRAM FOR MICR TEXT AREA AND BACKGROUND AREAS
DENSITY DISTRIBUTION AFTER AVERAGING
FREQUENCY
300
250
200
150
100
50
30
0
82
81
80
PMin
PMax
0
20
50
100
150
200
255
DARK
DENSITY
LIGHT

FIG. 8

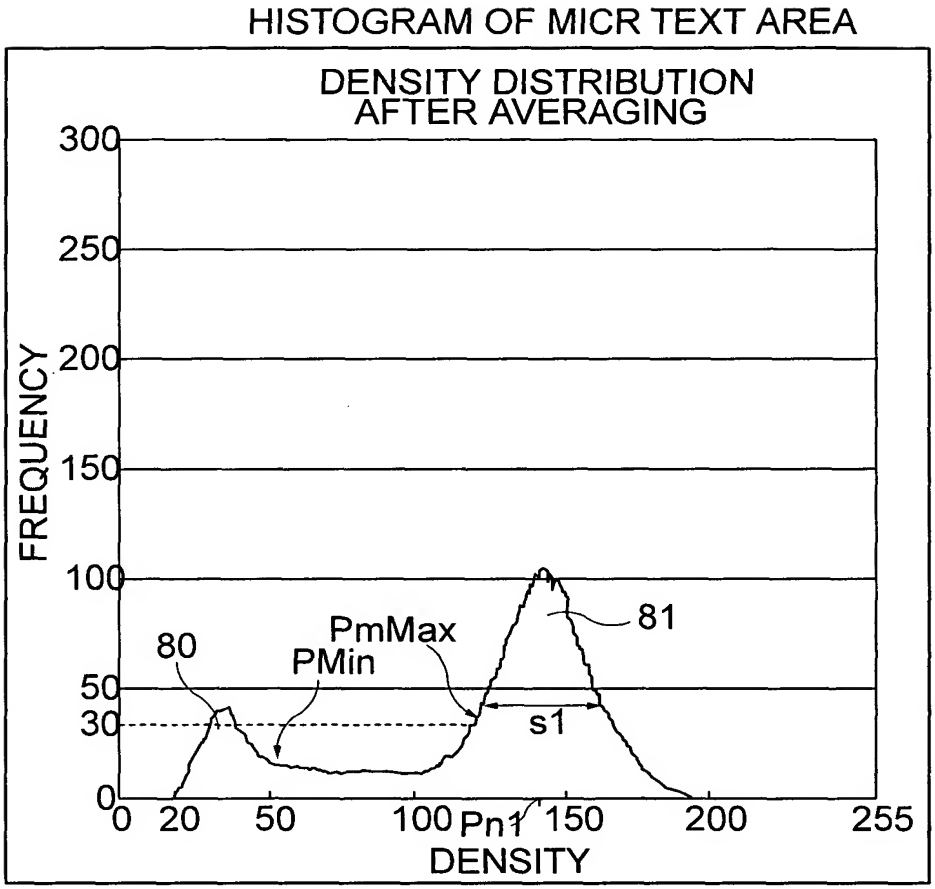
HISTOGRAM OF MICR TEXT AREA
DENSITY DISTRIBUTION
AFTER AVERAGING
FREQUENCY
300
250
200
150
100
50
30
0
80
PmMax
PMin
81
s1
0
20
50
100
Pn1
150
200
255
DENSITY

FIG. 9

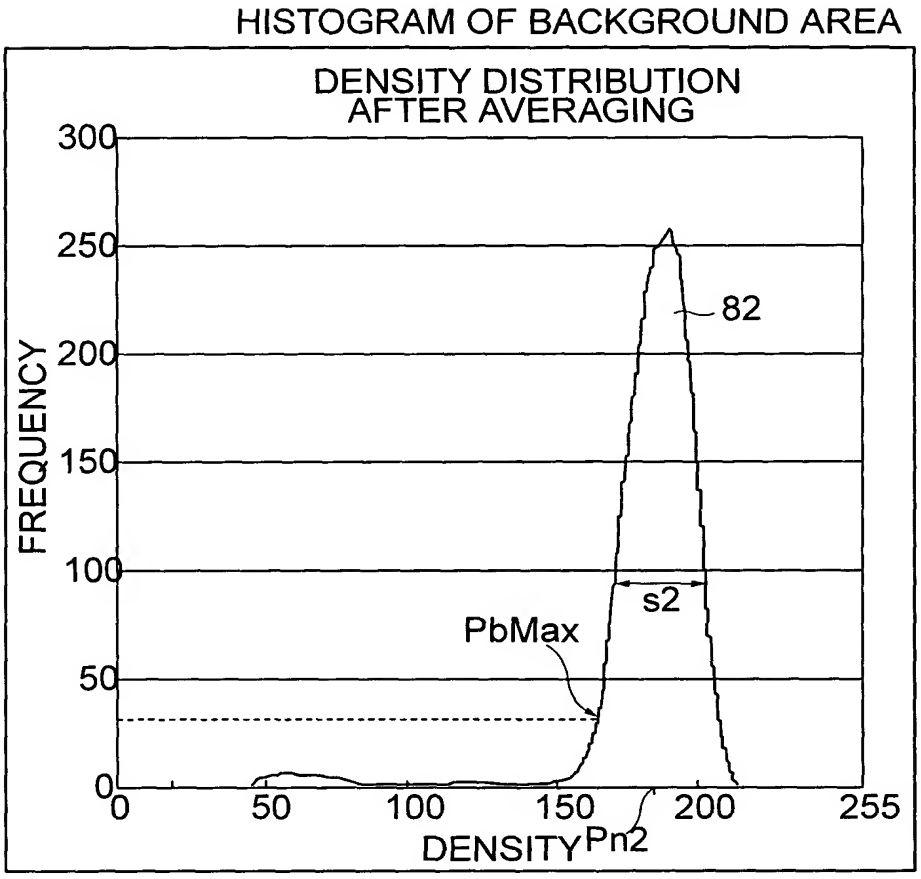
HISTOGRAM OF BACKGROUND AREA
DENSITY DISTRIBUTION
AFTER AVERAGING
FREQUENCY
300
250
200
150
100
50
0
82
s2
PbMax
0
50
100
150
200
255
DENSITY
Pn2

FIG. 10

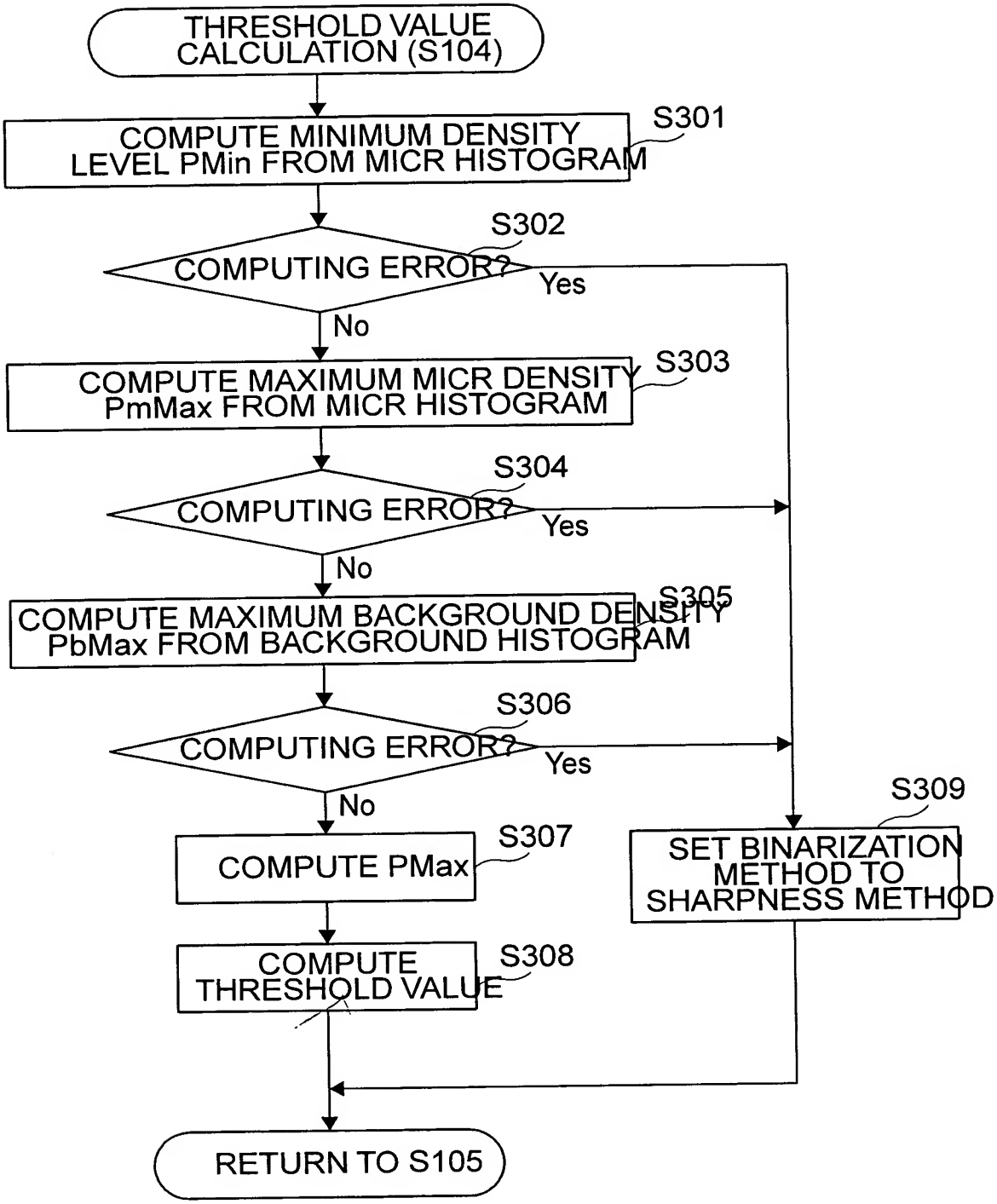
THRESHOLD VALUE CALCULATION (S104)
COMPUTE MINIMUM DENSITY LEVEL PMin FROM MICR HISTOGRAM
S301
COMPUTING ERROR?
S302
Yes
No
COMPUTE MAXIMUM MICR DENSITY PmMax FROM MICR HISTOGRAM
S303
COMPUTING ERROR?
S304
Yes
No
COMPUTE MAXIMUM BACKGROUND DENSITY PbMax FROM BACKGROUND HISTOGRAM
S305
COMPUTING ERROR?
S306
Yes
No
COMPUTE PMax
S307
COMPUTE THRESHOLD VALUE
S308
SET BINARIZATION METHOD TO SHARPNESS METHOD
S309
RETURN TO S105

FIG. 11

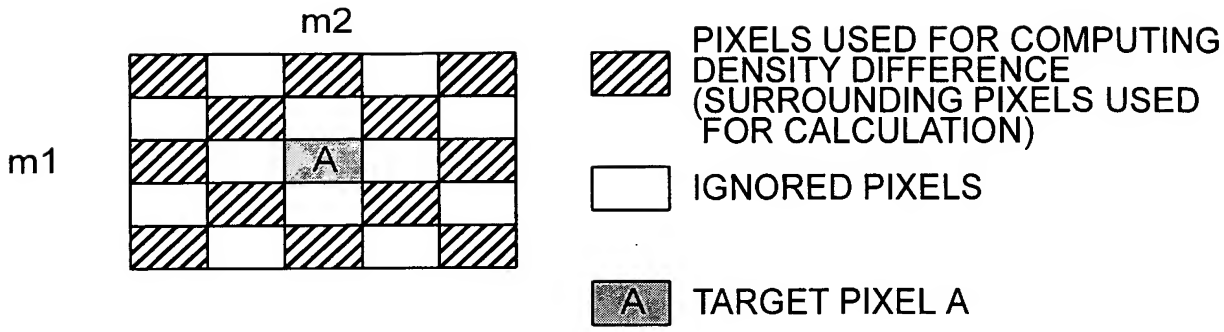

FIG. 12 (a)

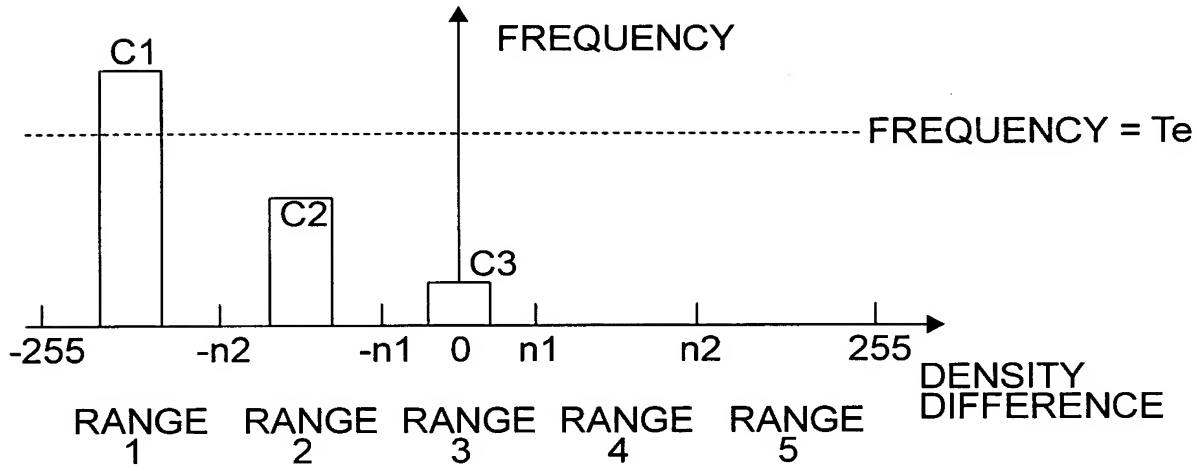

FIG. 12 (b)

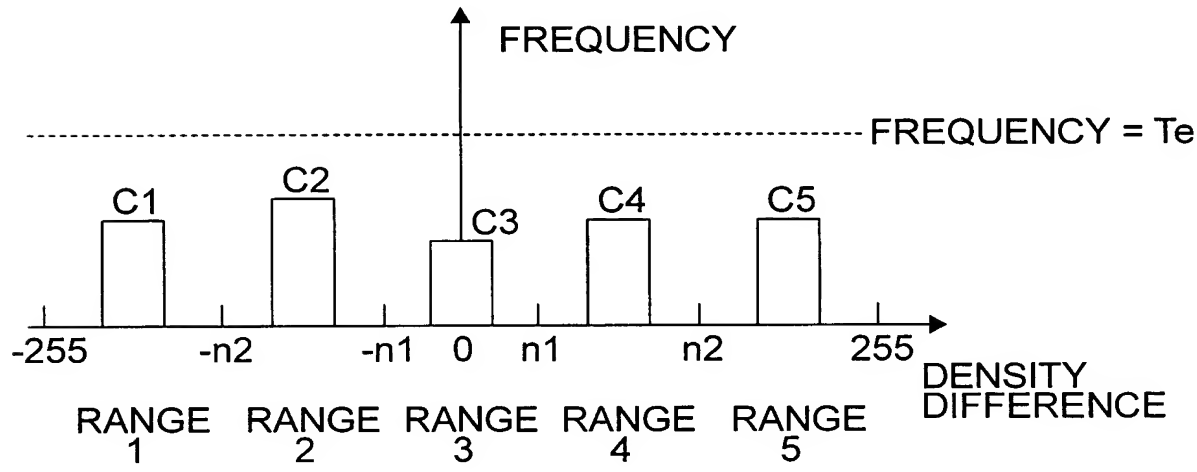

FIG. 12 (c)

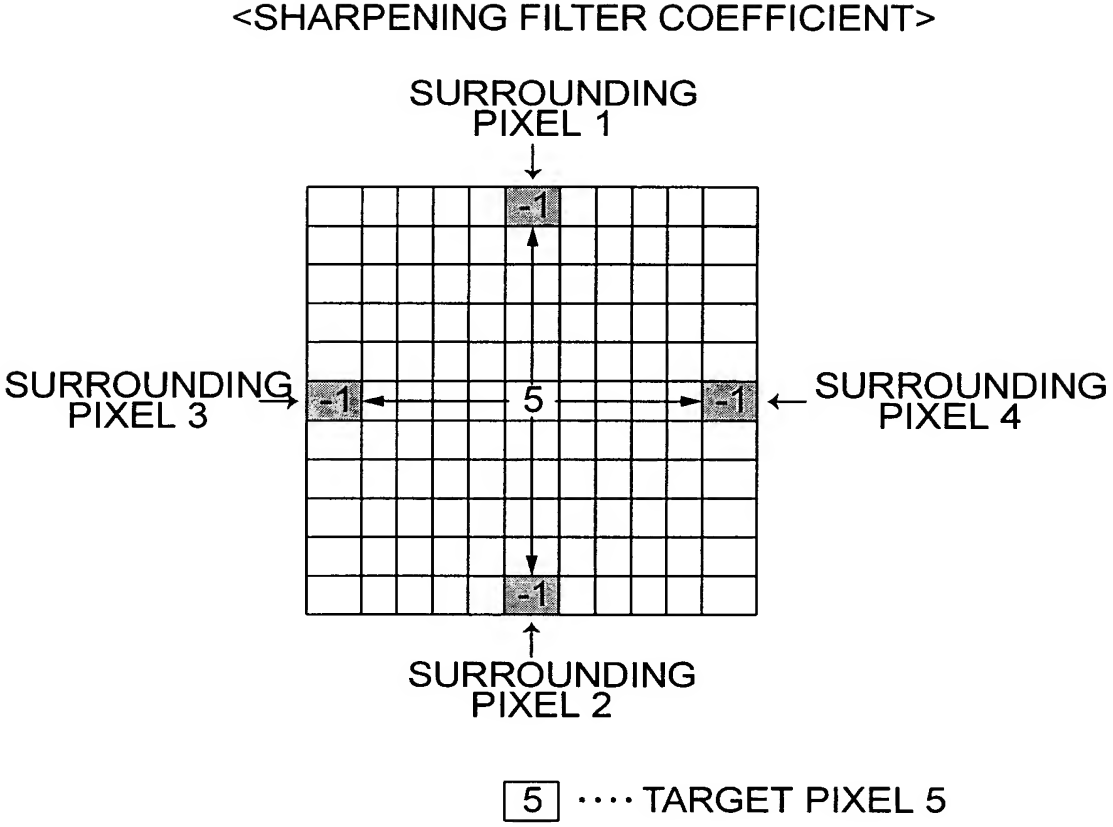
<SHARPENING FILTER COEFFICIENT>
SURROUNDING PIXEL 1
SURROUNDING PIXEL 3
SURROUNDING PIXEL 4
SURROUNDING PIXEL 2
-1
-1
5
-1
-1
5 .... TARGET PIXEL 5

FIG. 13

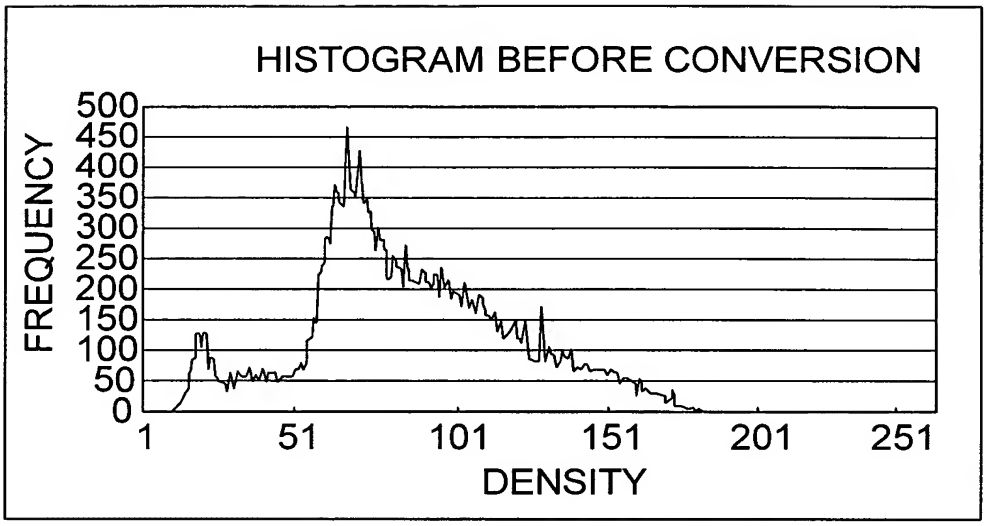

FIG. 14 (a)

APPLY SHARPEN FILTER

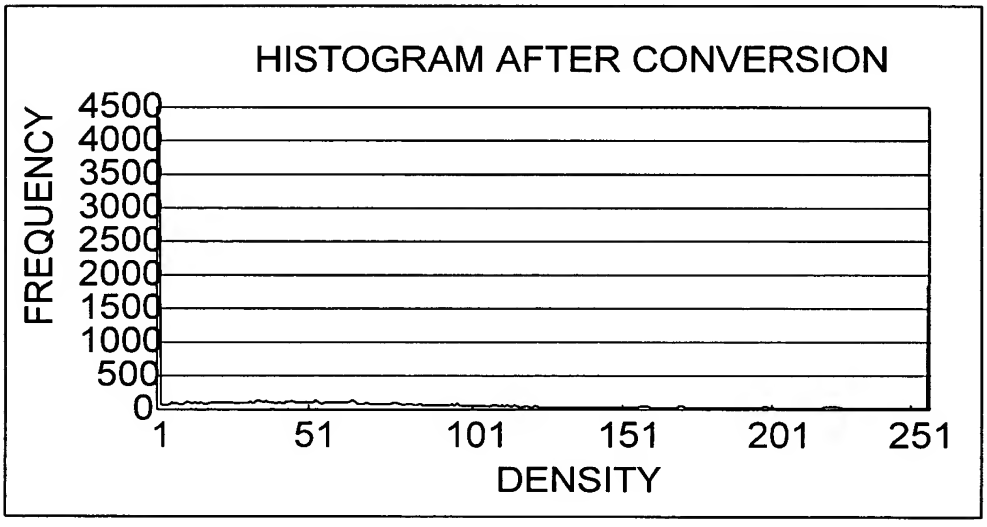

FIG. 14 (b)

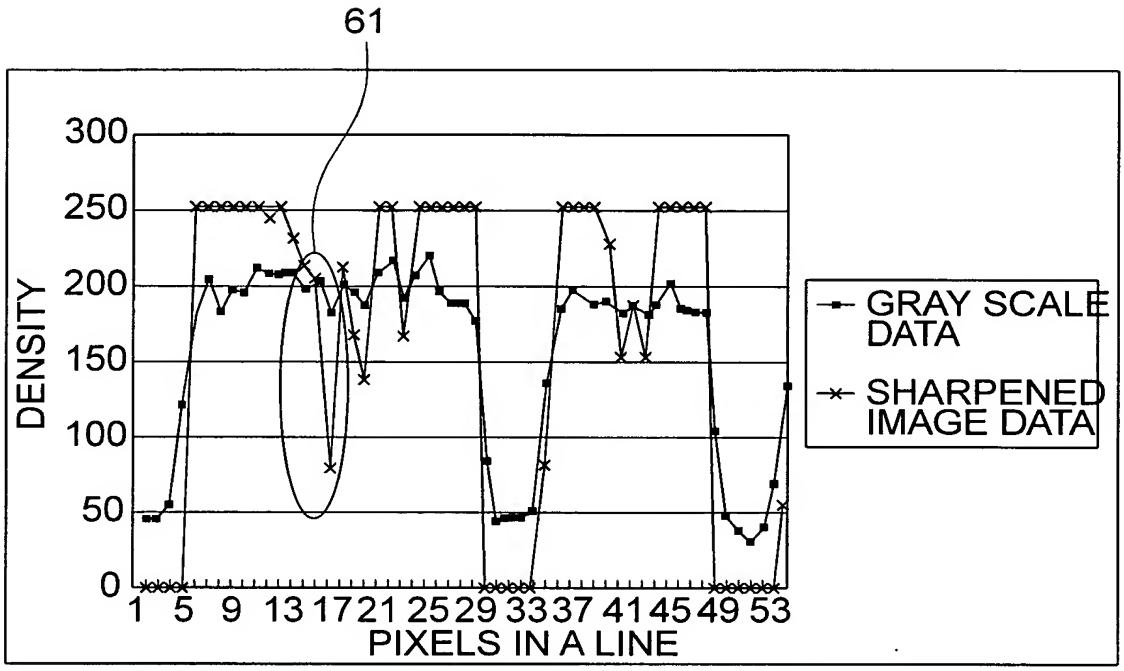
61
300
250
200
150
100
50
0
DENSITY
1 5 9 13 17 21 25 29 33 37 41 45 49 53
PIXELS IN A LINE
GRAY SCALE DATA
SHARPENED IMAGE DATA

FIG. 15

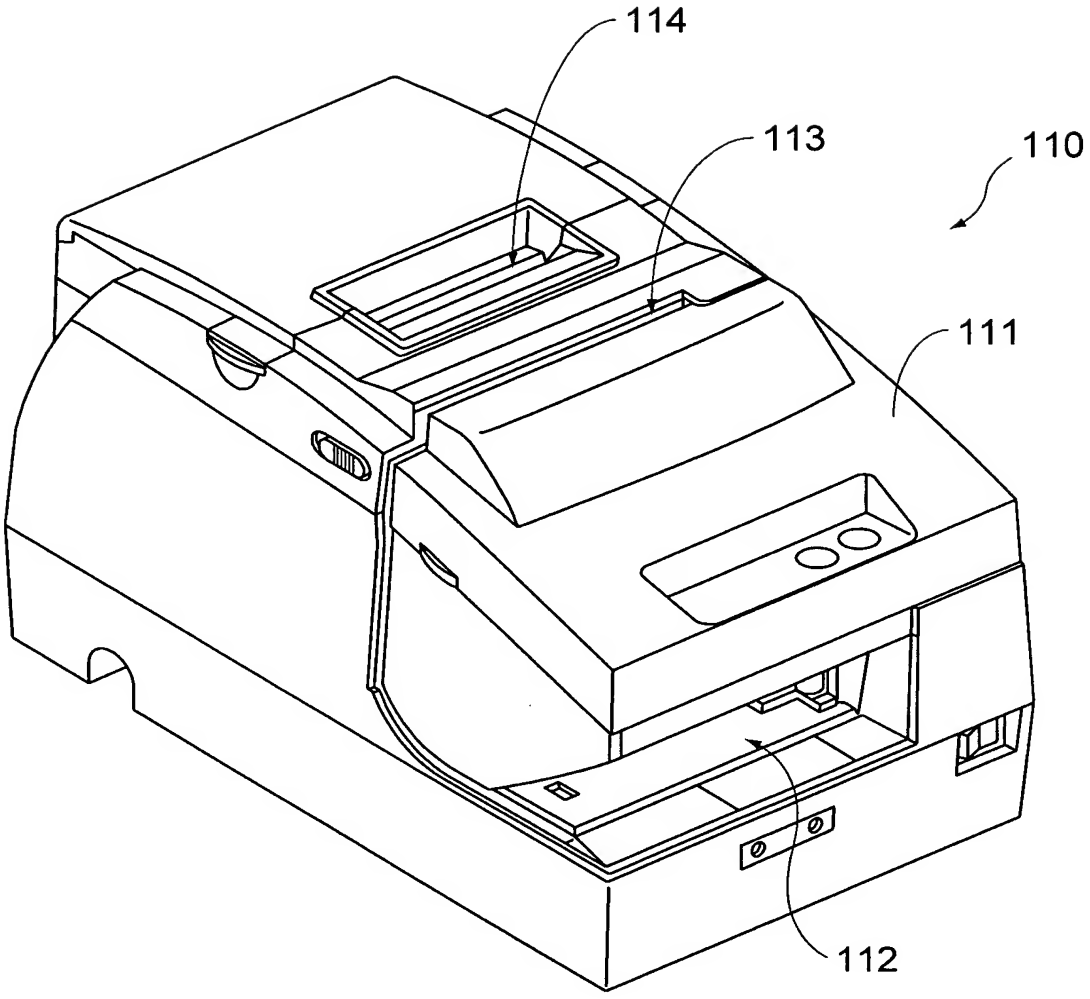

FIG. 16

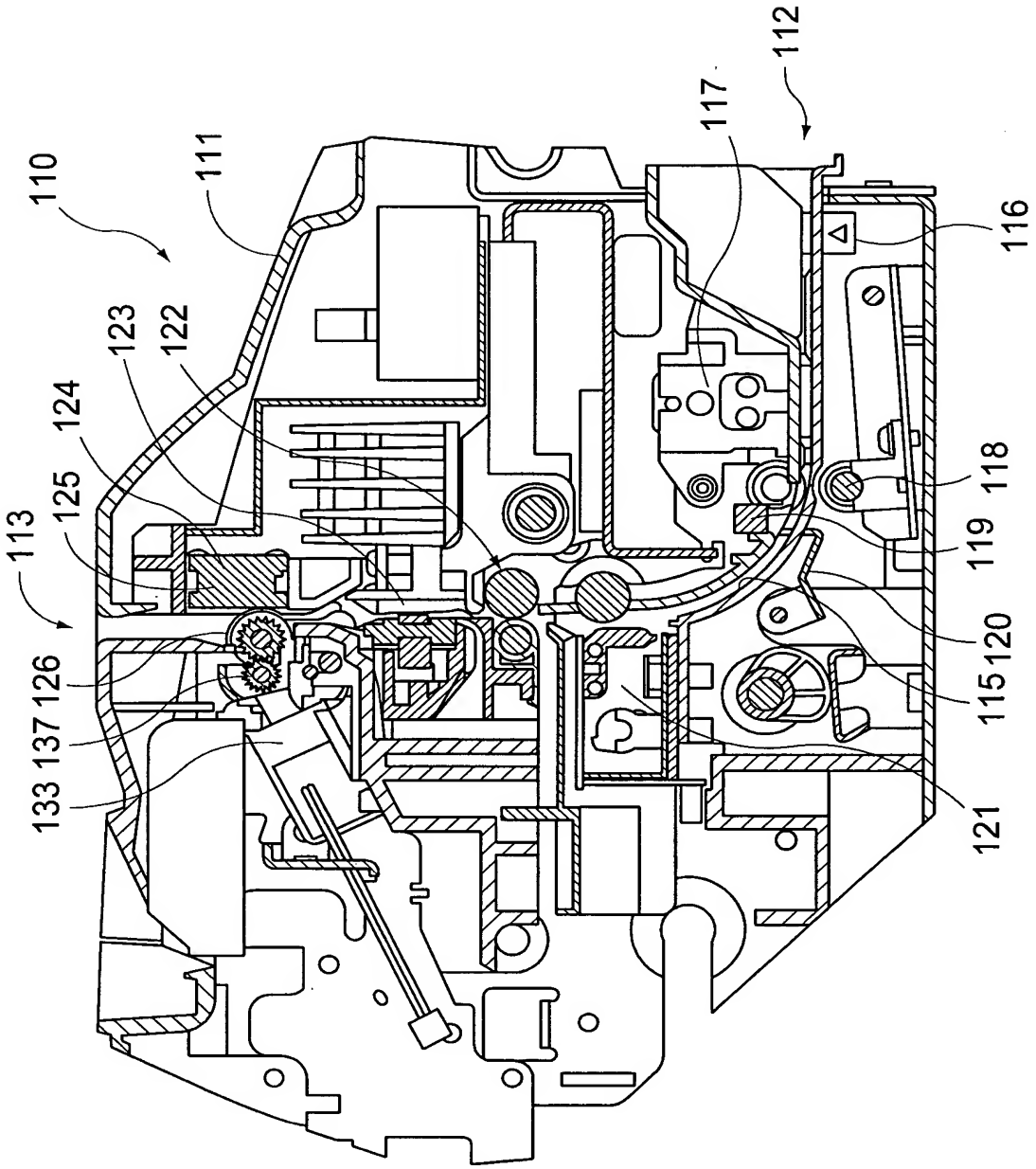
110
111
112
113
116
117
118
119
120
121
122
123
124
125
126
133
137
115

FIG. 17

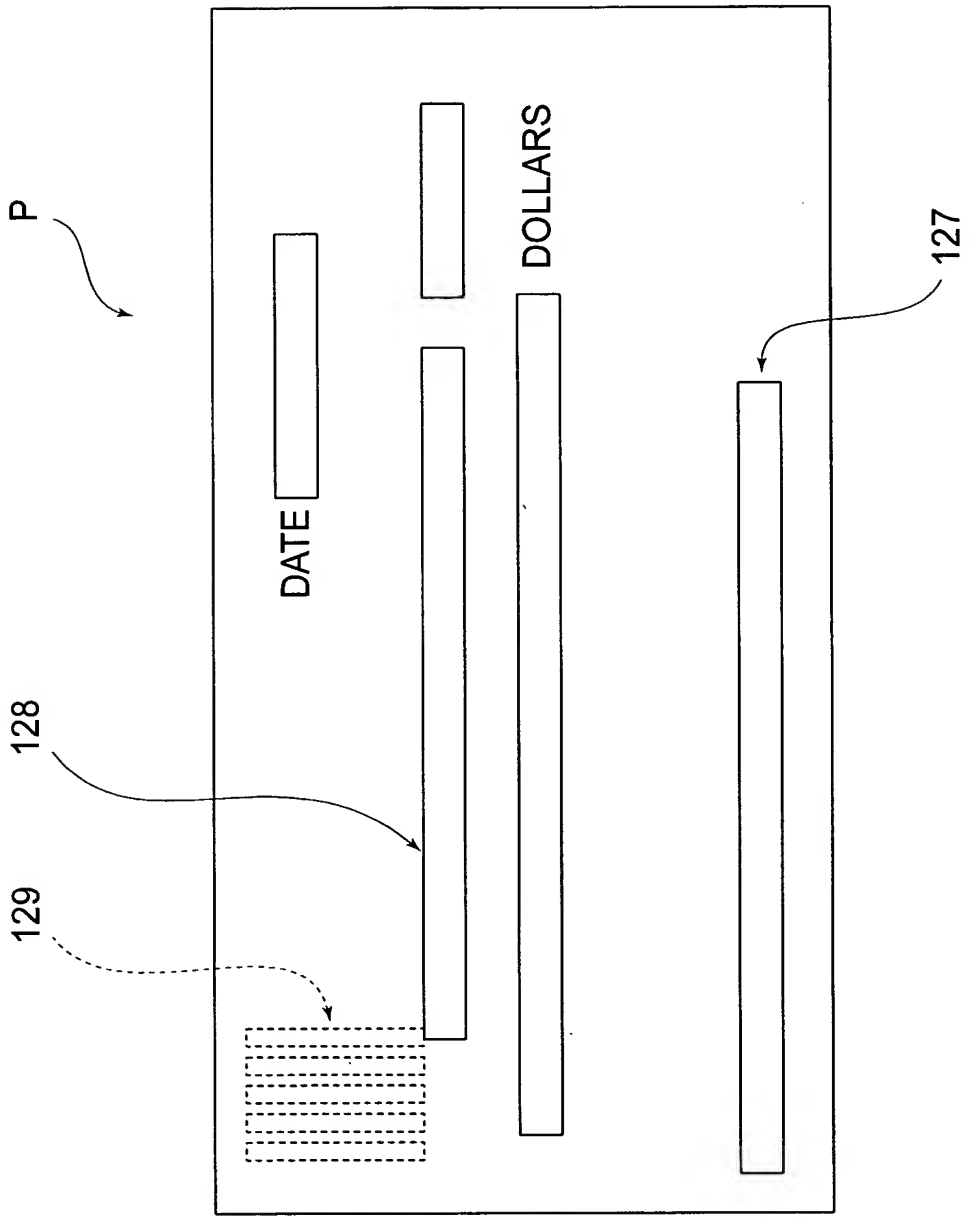

FIG. 18

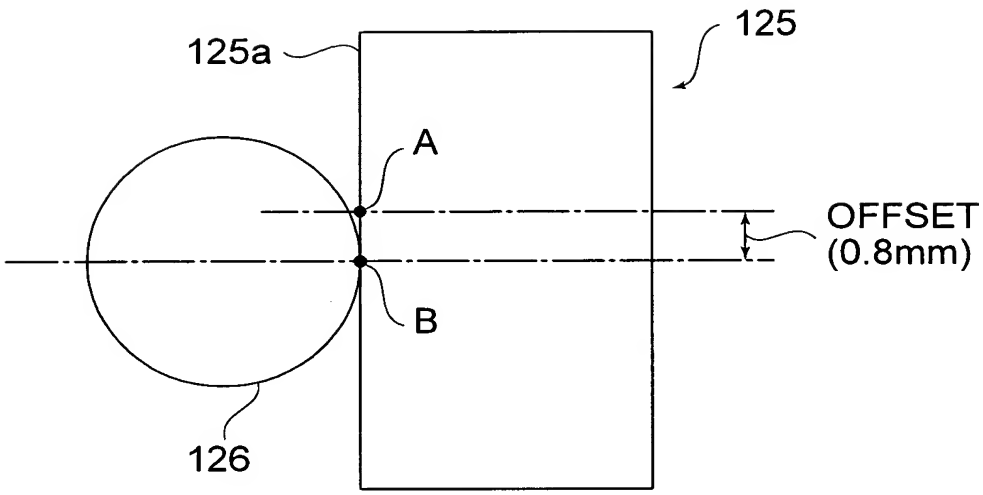

FIG. 19